a tendency to form three rows; while the bones of the digits differ chiefly in the small number of bones in each, and in there being four digits on the hand and five on the foot.

The Anatomy of two Parasitic Forms of the Family Tetrarhynchidæ.

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[Read May 6, 1874.]

(Plates XXIV.–XXVI.)

These two forms of the Tetrarhynch family, suborder Cestoda (*Cobbold*), among parasites, were obtained from the stomach of a Shark (*Carcharias* —— ?), and transferred to me by Dr. Macdonald, R.N., F.R.S. Of the larger form there were three specimens, of the smaller five; and with them was a portion of the shark's stomach, to which one of the larger forms was attached, the rest of the parasites being loose in the alcohol in which the whole mass was preserved.

The mucous membrane of the stomach was irregularly superficially ulcerated in spots to the size of a shilling; and narrow channels diverged from the surface of the ulcer into the subjacent tissues to the depth of $\frac{8}{100}$ to $\frac{15}{100}$ of an inch, these channels generally being arranged in pairs and evidently produced by the proboscides of the parasites for anchoring themselves; while with some there was also a broader pit, from which the channels diverged, produced by the partially immersed head of the creature. Around these channels for at least $\frac{1}{2}$ an inch there was marked dark discoloration of the tissues from blood-extravasation and disintegration. One of the larger forms was still attached; but since the stomach had been cut into pieces it had moved; for it was now anchored to the fresh incised surface. No part of the head of the parasite was inserted into the stomach-coats, so that the suckers were not called into action; but the proboscides diverged from each other into the tissues, having a broad base of attachment; and a considerable application of force relative to the size and strength of the tissues of the creature was used without the anchors giving way.

Whether these forms of animal life are new to science or have been already described and named, I cannot clearly ascertain; but as far as I have been able to follow the literature of the subject, I can find no mention of them; this, however, is far from proving them to be novelties. Considering the wide-spread field of knowledge at the present day, it is unquestionably far from easy to find out all the written matter on any given subject; and as regards helminthology, the difficulties of connecting one form with another under right classification appear extra plentiful, and notably with the Tetrarhynch family; so that I am somewhat diffident in making statements which may be shown to be incorrect by those who have made the subject an especial study, or who have an extensive special literature to fall back upon. The description of these parasites is entirely based on my personal observations of their anatomy; but as it is necessary to affix to them some designating term for identification, I have appended to each a *provisional name* based on the chief characteristic features present and qualified by the genus of the animal upon which they preyed. It is quite clear that while both belong to the Tetrarhynch family among Cestode parasites, the divergencies from each other in general outline, on the point of suckers, in the arrangement and shape of proboscides, and in internal structure indicate them as belonging to different genera. The larger one comes under the genus *Tetrarhynchus*, while for the smaller one I can find no place; and as it is especially distinguished by the absence of suckers, I apply the generic term *Abothros* (α, βόθρος), qualifying the generic designation of both by affixing to them the adjunct *carcharias* for specific differentiation.

The anatomical details of these forms are as follows:—

Tetrarhynchus carcharias.—This animal, in natural size and shape, is depicted in figs. 1 and 2, from which it will be seen that the parasite consists of a head and a linear series of segments much resembling a body, the two joined at a constricted portion, the neck. The total length equals $1\frac{6}{10}$ inch. The head (*a*, figs. 1 and 2) is ovoidal, flattened from before backwards, edges rounded off, surface perfectly smooth, structure firm, opaque, white in colour, with two fossettes, or suckers, and four proboscides; in dimensions $\frac{25}{100}$ inch long by $\frac{18}{100}$ broad, by $\frac{12}{100}$ thick. The neck (*b*, fig. 2) is a mere constriction, the limiting point of the cephalic structures on the one hand, and the point from which the segments progress on the other, $\frac{13}{100}$ inch broad by $\frac{5}{100}$ thick. The zooid colony (*c*, fig. 2) diverging from the neck, and somewhat in excess of it in all dimensions, follows the Cestoid order of worms in being flat, narrow, and thin, and measured $1\frac{3}{10}$ inch in length by $\frac{18}{100}$ broad and $\frac{6}{100}$ thick; yellowish white in colour, firm but flexible in structure, with closely approximated delicate transverse furrows (somewhat under 100 in the space of an inch) mapping off the component segments, and deeper longitudinal wrinkles on the flat anterior and posterior surfaces, giving a trilobar arrangement to the body-constituents of the zooid (as seen in fig. 3, a transverse section). It will be observed that the lower segments contract somewhat instead of increasing in breadth, as in the tapeworm colonies, and terminate in a sort of tubercle or nodule (*d*, fig. 2); this was the case in two out of the three specimens at my disposal, while the third, although somewhat contracting towards the lowermost segments, yet presented a flat end—a feature apparently dependent upon these parasites being in the early period of growth of the mature stage.

On the broad surfaces of the head, within the upper half, are seated two oval depressions, bothria, fossettes, or suckers (fig. 2, *e*). These extend from the base of the proboscides in long diameter downwards, in dimensions $\frac{9}{100}$ inch long by $\frac{6}{100}$ broad by $\frac{3}{100}$ deep, but subject to variations in size in individuals and according to condition of tissues. A ridge slightly projecting into the hollow occupies the centre of the inner wall of each sucker lengthwise, rendering it partially bipartite, and above branches into two, one to each base of the double proboscis of its side. The head is thicker at its free end as compared with that adjoining the neck; and upon this free end from before backwards, from the upper end of one sucker to the other, in the centre, is an oblong platform with a deep furrow on each lateral side mapping it off from the rounded-off edges of the head, while at each end of the platform are situated the proboscides, four in all, but arranged in couples, one anteriorly, one posteriorly, each couple closely contiguous to the upper end of the sucker of its side (fig. 1). To the naked eye these proboscides, when exserted, look like small clubshape fringed projections placed in couples in lateral apposition to each other, but diverging at their free end, and give an extremely rough feel to the finger when drawn against them.

The more minute anatomy of the parasite is as follows, commencing with the structure of the colony for facility of description.

Fig. 3 is a transverse section through a segment at the middle of the colony; and it is at once apparent that there is a distinct separation of the visceral space (*f*) from the encircling body-constituents, the latter consisting of a cutaneous envelope and parenchyma compounded of a soft albuminoid material, muscular fibres, and inorganic nodules. The cutaneous envelope (fig. 3 *a*, fig. 5 *a*) averages $\frac{1}{7000}$ inch in thickness, consisting of a thin transparent chitinous layer externally, and a dark granular productive layer beneath. The parenchyma extends from the skin externally to the fibrous boundary of the visceral space internally, and is arranged as follows:—Next to the granular layer of the skin is a circular layer of involuntary muscular fibre, which for the space of $\frac{1}{770}$ inch is free from all intercepting fibres (fig. 5, *c*), but beyond that is intermingled with transverse muscular fibres, forming a continuous layer for about $\frac{1}{700}$ inch (fig. 5, *d*), after which they are both thickly studded with "calcareous particles," forming a well-defined layer of $\frac{1}{60}$ inch thickness, and following the contour of the body-surface (fig. 3, *c*; fig. 4, *c*; fig. 5, *e*). The transverse fibres, although forming a continuous layer outside the inorganic granule layer, yet on the inside of it are collected into uniform thin bands, which form a meshwork enclosing the soft albumenoid material and the longitudinal muscular bands of the body (fig. 3, *d*; fig. 6, *a*); and this meshwork is continued on to the fibrous boundary of the visceral space. The longitudinal muscular bundles (fig. 4, *d*) pass continuously, for the major part, from one segment to the other throughout the colony.

As regards the inorganic accretions ("calcareous particles") (fig. 7), these are oval spherical or somewhat irregular in outline, homogeneous, or made up of concentric laminæ arranged around a nucleus, pale yellow or brownish in colour; average size $\frac{1}{1000}$ inch. The major number are composed of lime carbonate, the minor (generally irregular in outline) of phosphates or inspissated fat compounds. The use and mode of arrangement in particles of this inorganic layer is apparently, as I have elsewhere more fully stated *, for the purpose of giving a firmness to the body-structure while allowing at the same time of pliability and movement of the one part upon the other.

A distinct fibrous layer divides the body-parenchyma from the visceral substance; it is connected to the inner surface of the cuticle at the lateral edges of the zooid (fig. 3, *e*), and is continued longitudinally from one segment to the other, passing up

* Quarterly Microscopical Journal, January 1875, p. 6.

through the neck into the head, as will be subsequently detailed. The visceral space averages $\frac{1}{40}$ inch in thickness, and occupies the centre of the segment (fig. 3, *f*; fig. 4, *f*). It contains a granular homogeneous albumenoid material with a few interspersed inorganic particles; and although not presenting, in the segments of any of the three parasites from which these details are taken, any trace of viscera, yet, following by analogy the developmental process in the allied family of Tapeworms, it is within this, and from this, that the generative viscera are produced. At each lateral end of the visceral space, at a distance from the sides of the segment of $\frac{1}{20}$ inch, is seated the cut lumen of the longitudinal water-vascular canals (fig. 3, *g*). These canals, $\frac{1}{150}$ inch in diameter, are mere channels in the substance lined by a delicate fibrous-tissue layer; the longitudinal ones pass from one segment to the other, and, as in the *Tænia mediocanellata*, are met by a transverse branch special to the segment, seated in the lower portion of the visceral space of each zooid—the combination of the two series of tubes giving to the system of vessels of the colony the aspect of a ladder. The transverse branches are oval in outline, and smaller than the longitudinal branches; they necessarily approximate closely in the front segments of the colony (fig. 4, *g*), and diverge more and more from each other in the progressive development towards maturity.

The only other feature of the segments to be noted is the contracted bulbous condition of the lowermost one above referred to. On section under the microscope this gave the structure and appearance of a collapsed vesicle thickly studded with "calcareous corpuscles;" and the inference drawn from it and the lower end of the colony is, that these parasites were in the early progress of growth towards maturity from the larvæ recently introduced into the stomach of the shark, and that the nodular free end was the remnant of the original vesicle not yet, in two of the parasites, thrown off, while in the third, as above mentioned, this had ensued. I may here state, too, another feature which appears to bear out this deduction. In one of the animals one of the divergent petaloid appendages of the head arranged in a circle at the base of the proboscides was present, while in the other two animals there was no trace of them nor of the three others in the same parasite. These four appendages appear to be common among the mature Tetrarhynchs, and more especially among the larvæ; and the existence of one under the circumstances mentioned would appear to indicate that not only were these forms in the Shark at an early stage of mature condition of cestoid life, but that these appendages in some forms of the Tetrarhynchidæ, although present in the larval condition, are thrown off when the creature reaches the nidus requisite for full development.

The constricted portion of the parasite colony (the neck) is similar in structure to the other segments; the body-constituents, the fibrous visceral boundary, and the longitudinal water-vascular canals pass through it to the head, there to be modified to the special requirements of this part of the parasite.

The head is composed of two suckers, four proboscides, with four bulbs and adjuncts for extrusion and withdrawal of the proboscides situated within an expansion of the visceral boundary continued through the neck and with a stratum of parenchyma between them and the cuticular surface. In the upper half of the head are the suckers and proboscides, in the lower half the bulbs (fig. 1, *b*). The naked-eye aspect of the fossettes or suckers I have already given; and to this must be added that the chitinous layer of the skin forms the lining membrane, and that within this are special layers of muscular fibres for the regulation of the function, these being retained within a fibrous capsule following the contour of the sucker at a distance of $\frac{1}{90}$ inch, and separating the special muscles from the general parenchyma of the head (fig. 9, *e*, and fig. 12, *b*). Among the special muscles are radiating fibres which pass from the cuticular lining of the sucker to the capsule (fig. 9, *c*); and these would by their action induce the function: others pass from one side of the sucker to the other, encircling it both laterally and vertically; and these would contract the cavity of the hollow and so put a stop to the sucking function, the lateral fibres especially running in a separate layer from the rest (fig. 9, *d*). From the inside of the fibrous capsule of the sucker diverging muscular fibres pass into the general parenchyma of the head; and these would render the capsule firm for the special radiating fibres to act from (fig. 12, *c*).

Fig. 11 illustrates an exserted proboscis, magnified, and fig. 12 one all but retracted, a slight eversion of the hooklets at the base being preseut. The exserted proboscis is short, thick-set, club-shaped, somewhat broader near the free end than at the base, $\frac{5}{100}$ inch long by $\frac{3}{100}$ inch thick. It is closely studded with hooklets with points directed downwards; the number and arrangement of them it is impossible to determine accurately, from the close apposition of one to the other; there cannot, however, be less than one thousand on each proboscis; and the rows of them appear to wind spirally to the top. When the proboscis is retracted, the tips of the hooklets point upwards and converge towards each other in the centre of the hollow cylinder then formed. This will be apparent on comparing fig. 12 with 11, and on remembering that the evolution of the proboscis is similar to the drawing-out of the inverted finger of a glove; the simile will render lucid also the process of boring into the tissues, and how in the gradual unfolding of the armed projectile the rows ot hooklets come into play, those near the base being firmly fixed before the coming into action of those nearer the tip. The hooklets differ somewhat in shape and size according to situation upon the proboscis, whether towards the base or near the free end; if the former, then the characters are seen in fig. 10; but towards the free end the claw is lengthened out and straighter, clearly for the purpose of giving these a wider range of action; their average length is about $\frac{1}{100}$ inch. Their tip is very sharp, the limb is curved, the base is extended out and flat; the structure is transparent, and apparently consists of a very dense outer sheath and a soft granular internal core; the base is firmly attached to the surface of the proboscis. I am inclined to consider, from the facts of acids having no influence on them, and prolonged immersion in strong liquor potassæ and glycerine rendering them soft and pliable, that the composition of the hooklets is chitinous, similar to the claws of rapacious birds. Fig. 12 shows the proboscis to be muscular in structure, contained within a special thick sheath separating it from the general parenchyma of the head. Immediately within the sheath is seen a layer of muscular fibre forming an outer cylinder (fig. 12, *e*), the fibres directed vertically; these appear to arise low down from the inside of the sheath, and, passing upwards to the base of the proboscis, curve (in the inverted condition) inwards and downwards, but in the exserted state are continued up, forming the outer stratum to which the base of the hooklets is attached, and eventually merging into the strong circular muscle for the retraction of the proboscis (fig. 12, *g*). Commingled with this outer layer, where it is in contact with the hooklets (*i. e.* where it helps to form the proboscis), is a circular layer of fibres entirely limited to the proboscis (fig. 12, *f*), while from the most inverted end of the proboscis (or forming the core of it when exserted) a strong circular muscle passes downwards and terminates in a tendon (fig. 13) which is continued on to the bulb (figs. 14 & 16). The action of these layers is apparent from the direction of the fibres; the outer cylindrical layer evolves the proboscis; the circular layer gives it stability and firmnesss; the thick circular basal muscle retracts it. These muscular layers are made up of solid cylindrical fibrillæ arranged parallel to each other and of an exquisite delicate yet decided texture; moreover there are transverse markings upon them which are not sufficiently regular to be pronounced striæ, yet unquestionably they closely approximate voluntary vertebrate muscular tissue*. The sheath of the proboscis is kept *in situ* by muscular bands and fibrous tissue which diverge from it into the surrounding head-substance; and at the point where it contracts with the tendon of the muscle (fig. 13, *d*), there the fibres are very strongly pronounced. The retractor muscle is $\frac{8}{100}$ inch in length by $\frac{2}{100}$ inch in diameter; and its tendon passes down for a short distance, and merges into the muscular layers of the bulb.

These bulbs are four in number, one to each proboscis; they are elongated ovoidal structures, in shape markedly resembling a sausage, $\frac{5}{100}$ inch in length by $\frac{1}{100}$ inch in diameter; they are arranged side by side within the expansion of the fibrous visceral boundary of the colony, passing through the neck to merge in the cuticular layer of the free end of the head (fig. 8, *d*; fig. 16, *d*). In structure they are composed of planes of muscle whose fibres cross each other in all directions; these planes form an outer stratum covered externally by a prolongation of the sheath of the proboscis; and within this outer stratum are enclosed the special fibres connected with the retractor tendon (fig. 14). These special fibres are seen to pass on one side of the bulb (fig. 14, *a*, *b*) to its bottom and then to curve upwards on the other side to the top, near where they enter, apparently there merging in the fibres of the outer stratum. That this intricate arrangement of muscular bands is connected with the retraction of the proboscis cannot be questioned, and would appear to be dependent on the shifting position of the central tendon in the exserted or retracted state of the proboscis; for in the process of *inversion* (accomplished by the upper fibres of the central tendon, retractor

* The recent observations of Mr. Schaefer on the structure of muscular fibre (voluntary) seem to me to throw light on this point and also receive light from these details.

proboscidis muscle) the presence of the bulb fibres would be necessary to withdraw the tendon, shifted gently upwards during evolution, and so to give a moveable yet firm point from which the upper fibres could operate. The bulbs are firmly fixed by their lower end; and as the process is better exemplified in the succeeding parasitic form, the subject is there entered upon.

The parenchyma of the head has the same components as that of the segments, only differently arranged. Internal to the chitinous skin are the circular fibres; and succeeding these is the inorganic stratum, much more sparsely amassed. The radiating fibres are not collected into a network, but pass generally dispersed from the skin to the fibrous layer encircling the bulbs, and are equally intercepted by the longitudinal fibres which extend from the head throughout the entire colony. In the neck the longitudinal water-vascular canals are clearly present (fig. 8, *c*), only reduced in calibre; but what becomes of them in the upper part of the head I cannot state, not having been able, from the limited number of parasites at my disposal, to accurately trace them out.

Abothros carcharias.—In the description of this parasite I shall mainly limit the anatomical details to those points in which it diverges from the former species.

Fig. 15 gives an outline of the animal form, natural size—in which are distinguishable the head, the segmented colony, and the apparent junction between these. The head (*a*) is in shape an elongated ovoid slightly flattened from before backwards, $\frac{34}{100}$ inch long by $\frac{8}{100}$ broad by $\frac{5}{100}$ thick, bevelled off towards the free end, from which at the extreme point the proboscides emerge. A few longitudinal furrows are present; otherwise its surface is uniform and smooth, in colour a dark red, more intense towards the free end, where it it is often black; there are no fossettes or suckers. The extent of the colony attached to the head in any one of the specimens did not measure more than 2 inches in length, the delicate striated band of zooids $\frac{7}{100}$ inch broad by $\frac{1}{100}$ inch thick, having suffered rupture in every instance; yet at least 200 segments were present. The milk-white colour of the colony strongly contrasted with the dark red head. At the apparent point of junction of the head and colony (fig. 15, *b*) there was no constricted portion to call a neck; but the upper end was invaginated in the head to the extent of $\frac{13}{100}$ of an inch, or, to put it in other language a gradually thinning cylinder of tissue from the head enveloped the first part of the colony to this extent (fig. 17, *b*). There was no trace of genital orifices in any of the segments.

A vertical section through the head is seen in fig. 16, and a transverse section in fig. 19, showing the arrangement for the movements of the proboscis to be similar in both parasitic forms. From the bottom of the bulbs a dense mass of fibres pass, which form a circular band traceable through the centre of the head downwards (fig. 16, *e*); these are evidently for the retention of the bulbs in their normal vertical position in the head. The proboscides in this species are narrow and elongated, $\frac{1}{300}$ inch long by $\frac{1}{3000}$ inch in diameter; the hooklets are of one shape and not so thickly studded, arranged in parallel spiral lines, along each of which on the side of the proboscis in view under the microscope five can be counted; and this would give to each proboscis about 400 hooklets in all (fig. 18); the average size of the hooklets is $\frac{1}{1000}$ inch. The proboscides emerge from the free end of the head in separate circular apertures placed at equal distances from each other; and these are mere orifices with no appendages. Immediately beneath the skin of the head is an immense quantity of dark, black pigment in the form of minute oval masses often arranged linearly, and also oval masses about $\frac{1}{3000}$ inch in diameter of a beautiful purple colour; and these give the special tinge to this part of the parasite. Surrounding the bulbs is a delicate fibrous layer; and in the parenchyma external to it are a few inorganic calcareous nodules arranged at definite intervals, and radiating and circular and longitudinal muscular fibres regularly penetrating it.

In fig. 17, a vertical section, is seen the mode of junction of the colony with the head. A distinct transverse band of fibrous tissue (*d*) forms the boundary line; and from this strong radiating bands (*c*) diverge upwards into the head, forming the link of the one to other. The structure of the enveloping cylinder of the commencement of the colony is similar to the parietes of the head; the cuticle at the free thin end is reflected upwards and inwards as a delicate layer to the level of the junction of colony and head, and is there continuous with the skin of the former. The first segments of the colony are very delicate in aspect and of great tenuity; and the collar prolongation from the head would act as a protection against external harmful influences.

The colony is distinctly segmented at intervals of about $\frac{1}{100}$ inch for the first $1\frac{1}{2}$ inch, and, to the naked eye, more approaches in form the young segments of tapeworms generally than that of the former parasite. In the structure of the segment we get the chitinous skin, subjacent granular layer, body parenchyma, visceral space, and water-vascular canals. The muscular layers of the parenchyma are transverse, circular, and longitudinal; and, as will be seen in fig. 21, the transverse fibres uniformly radiate between the skin and visceral boundary instead of forming a meshwork. The inorganic nodules are few, but similarly arranged and similar in composition and structure. Within the visceral space is the longitudinal water-vascular canal; and, as seen in fig. 20, this system is the counterpart of that in the former parasite. In the upper segments the granular visceral material is, as usual, with no trace of differentiation; but in the lowermost segments present in these parasites (about the 200th) there is a distinct separation of it into spherical masses, apparently ovarian vesicles (fig. 21, *d*), as far as can be traced, the process of development of the early zooids closely approximating that detailed as observed in the *Tænia mediocanellata* *.

Remarks.—These parasitic forms (Tetrarhynchidæ) are limited to water-residents, the larvæ being developed from ova taken in by certain among them, and the mature creature reached in the bodies of the predaceous species of fishes, mainly or wholly, which make the larval hosts their food, the cycle of changes being similar to that observed in the allied family of tapeworms. The strong resemblance of the colonies of the parasites of the Shark to that of *Tæniæ* is evident, the one, as in the other, being a series of semi-independent hermaphrodite zooids without alimentary canal, and with a water-vascular system closely connected in all. It is at the head end that the mature Tetrarhynchs mainly diverge from the *Tæniæ*, though here there are the same elements, only in a modified form, the limited rows of hooklets on a rostellum in the *Tæniæ* being developed in the Tetrarhynch into an armed lengthened proboscis, while the four or bipartite two suckers of the latter family are apparently similar in structure and function to those of the tapeworm. By the proboscis these parasites of the Shark are linked to the tape-worms armed with hooklets, while by the suckers the larger form shows its relation to the *Bothriocephalus* family. It is interesting to note the absence of suckers in the smaller form, although placed under the same conditions for maturity as the larger, inasmuch as in the other cestode

* Quarterly Microscopical Journal, January 1875, p. 16.

families the suckers are the constant feature, and the hooklets the variable, but reversed in the Tetrarhynchs; possibly the addition of the bothria or suckers in the one is connected with the extra weight of material to be anchored in the shape of breadth and thickness of colony as compared with the other. It will be observed that I have made no mention of nerve-centres in the anatomy of these animal forms, and for the reason that, though doubtless present, I am unable to distinguish any such among the components of the zooids. Considering the very intricate arrangement of fibres and granular material making up the parenchyma of the cephalic mass, the identification and tracing the method of arrangement and dispersion of nerve-fibres and ganglia must be a matter of extreme difficulty; and, in spite of a very careful and prolonged scrutiny, I cannot lay claim to any elucidation of this portion of the subject. The same may be said of those centres undoubtedly present (by inference) in each segment of the colony.

EXPLANATION OF THE PLATES.

Plates XXIV.–XXVI.

Tetrarhynchus carcharias. Figs. 1–14.

Fig. 1. Natural size: *a*, bird's-eye view of the free end of the head; *b*, section through the head, from before backwards, to show the position of suckers and bulbs.

Fig. 2. Natural size. Flat surface of the parasite: *a*, head; *b*, neck; *c*, colony; *d*, nodule at its free end; *e*, anterior sucker; *f*, anterior pair of proboscides.

Fig. 3. Magnified 15 diameters. Transverse section through a zooid at the centre of the colony-length: *a*, skin; *b*, circular and transverse muscles; *c*, inorganic layer; *d*, meshwork arrangement of transverse muscles; *e*, fibrous visceral boundary; *f*, visceral space; *g*, cut lumen of each longitudinal water-vascular canal.

Fig. 4. Magn. 15 diam. Vertical section, from before backwards, of several zooids in continuity about the centre of the colony: *a*, skin, showing the indentations at the junction of the several zooids; *b*, muscular layers, circular and transverse; *c*, inorganic layer; *d*, parenchyma with the longitudinal muscular bands; *e*, visceral boundary; *f*, visceral space; *g*, transverse water-vascular canals closely abutting upon each other.

Fig. 5. Magn. 200 diam. Transverse section through the body-parietes: *a*, chitinous layer of skin; *b*, granular layer; *c*, circular muscular fibres; *d*, transverse muscular fibres; *e*, inorganic layer.

Fig. 6. Magn. 200 diam. Continuation of former section to the visceral boundary: *a*, meshwork formed by the transverse muscular fibres beyond the inorganic layer enclosing *b*, the cut ends of the longitudinal muscular bands and the granular albumenoid material of parenchyma; *c*, fibrous boundary of the visceral space.

Fig. 7. Magn. 350 diam. Inorganic nodules "calcareous particles:" *a*, concentric laminated nodules of lime carbonate; *b*, homogeneous granules partly lime carbonate, partly phosphatic; *c*, inspissated fat compounds.

Fig. 8. Magn. 15 diam. Transverse section at the junction of head with neck at the lower ends of the bulbs: *a*, body-constituents, similar to fig. 3, *a–d*; *b*, expanded visceral boundary forming a capsule to *d*, the bulbs connected with the proboscides; *c*, longitudinal water-vascular canals.

Fig. 9. Magn. 100 diam. Transverse section through a portion of a sucker adjacent to the skin: *a*, cuticular lining to sucker; *b*, cuticle of skin of head; *c*, radiating muscular fibres special to sucker; *d*, transverse encircling band; *e*, fibrous capsule separating the special muscles from *f*, the general parenchyma of the head.

Fig. 10. Magn. 100 diam. A hooklet near the base of proboscis, showing the double contour and granular internal core.

Fig. 11. Magn. 40 diam. Exserted proboscis as seen from the flat surface of the head of the parasite.

Fig. 12. Magn. 40 diam. Vertical section carried from before backwards through an all but inverted proboscis: *a*, sucker; *b*, its fibrous capsule; *c*, the radiating bands of muscle from the capsule into the general parenchyma of head; *d*, sheath of proboscis; *e*, cylindrical layer of muscle for protrusion and evolving of proboscis; *f*, circular layer limited to region of hooklets; *g*, retractor muscle of proboscis.

Fig. 13. Magn. 40 diam. Continuation downwards of former section to show the termination of (*a*) the retractor muscle in the central tendon (*b*): *c*, sheath; *d*, radiating strong bands at the contraction of the sheath.

Fig. 14. Magn. 40 diam. Further continuation of section into the upper end of a bulb, to show the connexion of the fibres from the lower end of central tendon with the bulb: *a*, special muscular band from central tendon passing to the lower end of bulb and curving up on the opposite side (*b*) to merge into the outer strata.

Abothros carcharias, figs. 15–21.

Fig. 15. Natural size. *a*, head; *b*, point to which the outer cylinder of tissue from the head covers the first segments of the colony, *c*.

Fig. 16. Magn. 20 diam. Vertical section through upper part of the head: *a*, skin; *b*, inorganic layer; *c*, parenchyma with strong longitudinal muscular bands; *d*, bulbs for retraction of proboscides, *f*; *e*, strong band connected with the retaining *in situ* of the bulbs.

Fig. 17. Magn. 20 diam. Vertical section through lower half of head: *a*, colony of segmented zooids; *b*, prolongation of the substance of head as a cylinder of protection over the upper zooids; *c*, radiating bands connecting the colony with the head; *d*, fibrous boundary dividing the one from the other.

Fig. 18. Magn. 200 diam. About one third of free end of proboscis: *a*, central retractor muscle.

Fig. 19. Magn. 15 diam. Transverse section through the head: *a*, body-constituents; *b*, fibrous capsule around the bulbs, *c*.

Fig. 20. Magn. 20 diam. Front view of a segment about centre of the colony: *a*, the line of distinction between one and the other, immediately above

which is a light-shaded canal, the transverse water-vascular canal, which joins with the longitudinal water-vascular canal (*b*) at each lateral edge of segment.

Fig. 21. Magn. 65 diam. Transverse section through a part of one of the lowest zooids of the colony: *a*, skin; *b*, layers of muscular fibre and inorganic nodules; *c*, fibrous boundary of visceral space; *d*, ovarian vesicles in visceral space; *e*, lumen of longitudinal water-vascular canal.

Notes on the Lepidoptera of the Family Zygænidæ, with Descriptions of new Genera and Species. By Arthur G. Butler F.L.S., F.Z.S.

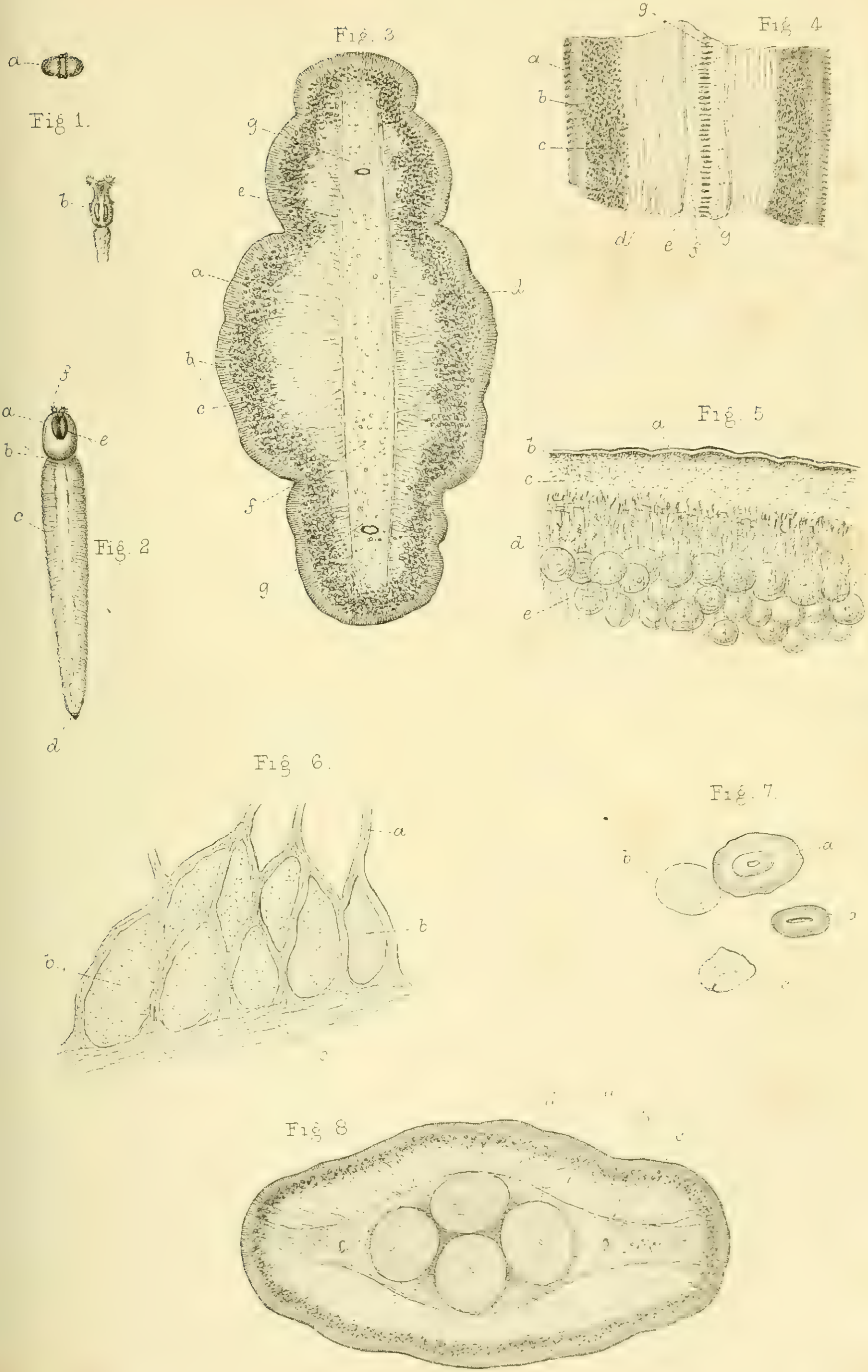
[Read May 6, 1875.]

(Plates XXVII. & XXVIII.)

In the present paper I propose to correct errors in the synonymy of the Family, chiefly occurring in Mr. Walker's lists. I shall not, however, pay much attention to the genera *Zygæna*, *Procris*, and other European groups, as I have not deeply studied them, and should possibly do more harm than good in sinking many of what seem to me undistinguishable species, but which may (for any thing that I know to the contrary) differ in their earlier stages. I have lately been made aware of the painful fact that species which in their perfect state are almost identical in every respect, are, in the larval condition, so dissimilar as to leave no doubt of their being distinct. This fact is perhaps in no instance better exemplified than in our *Chærocampa elpenor* and its Japanese representative *C. Lewisii*, mihi.

I find that in the Zygænidæ the neuration of the wings has been much neglected, so that in the groups Syntominæ (*Syntomides*, part., Herrich-Schäffer), Euchromiinæ, and Eunomiinæ I shall have to diagnose many new genera; when I do so I shall refer to them all the species described by Walker and appertaining to them. As regards the Charideinæ (Charideoidæ, *Wallengren*), as they are, to my mind, clearly a slightly aberrant group of Arctiidæ, and not Zygænidæ, excepting in external appearance, I shall retain them for a distinct paper.

I have paid most careful attention to the neuration of the wings in this highly interesting group, and I find the neuration of the Charideinæ to agree closely with *Phragmatobia* and other unquestioned genera of Arctiidæ; the only character that has been proposed, to my knowledge, by which any of them can be separated, is their metallic coloration—a poor character when we take into



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ig. 9.

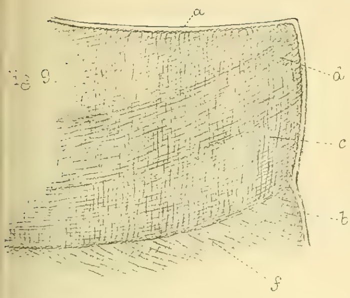


Fig. 10.

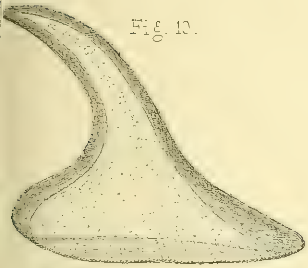


Fig. 11.

Fig. 12.

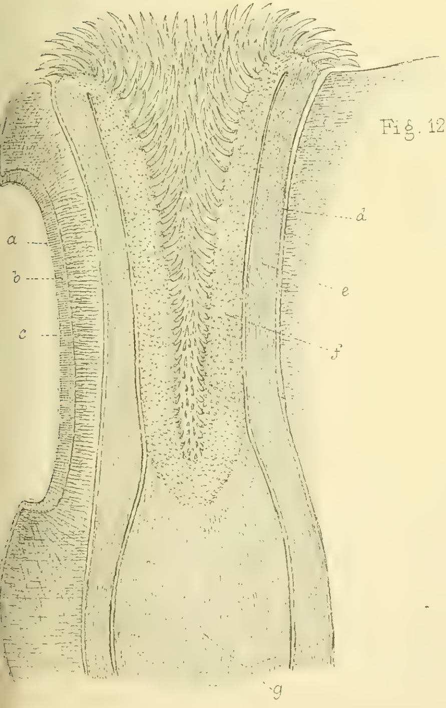
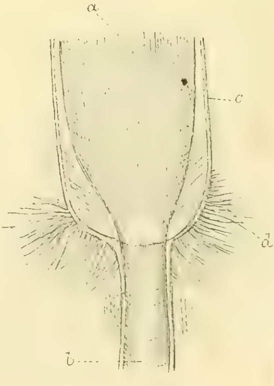
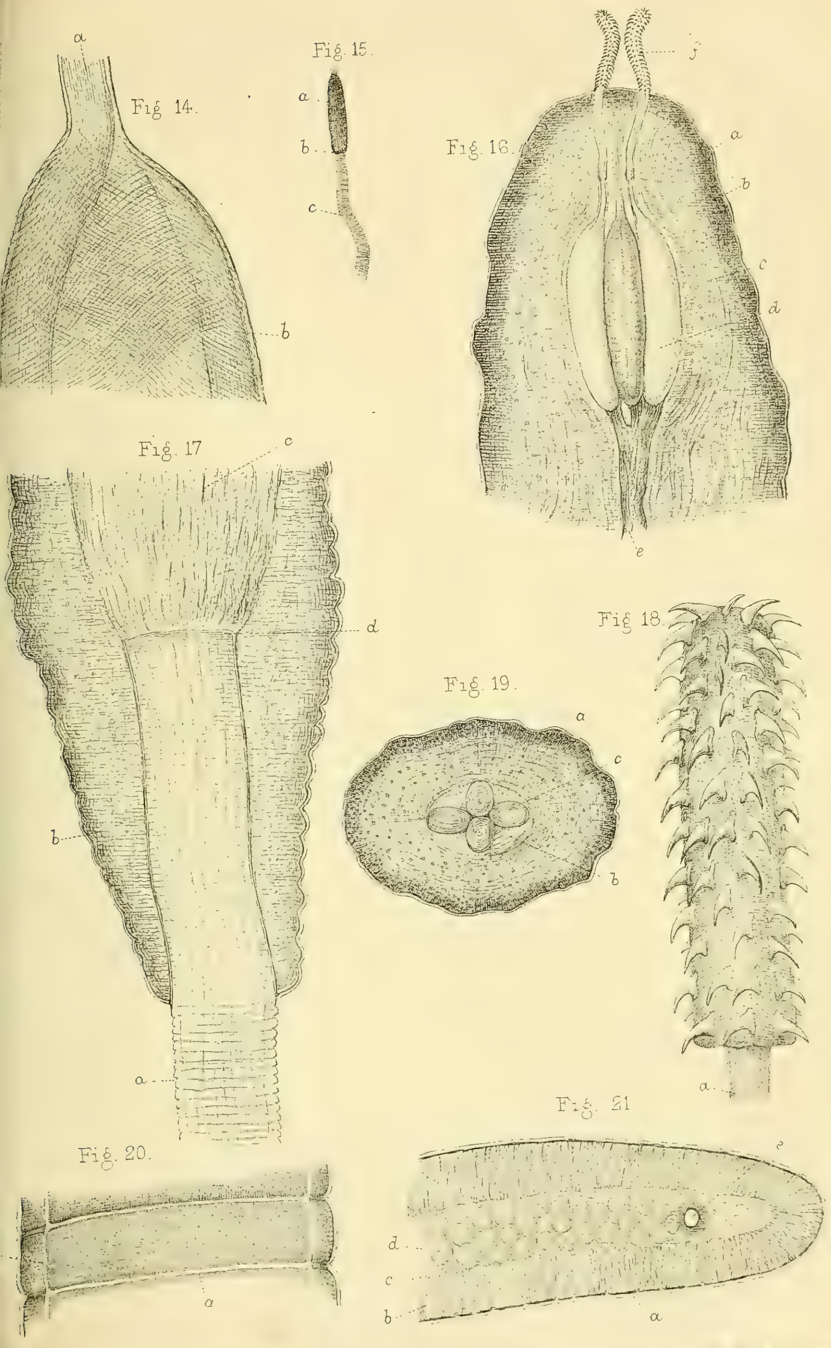


Fig. 13.





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